

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)

REC'D 05 JUL 2004

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Applicant's or agent's file reference P011711WO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB 03/01173	International filing date (day/month/year) 19.03.2003	Priority date (day/month/year) 20.03.2002
International Patent Classification (IPC) or both national classification and IPC F03B13/26		
Applicant HYDROVENTURI LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 20.10.2003	Date of completion of this report 02.07.2004
Name and mailing address of the international preliminary examining authority: <div style="display: flex; align-items: center;"> <div> European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 </div> </div>	Authorized Officer Giorgini, G Telephone No. +49 89 2399-7244



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB 03/01173

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1, 3-8 as originally filed
2, 2a received on 01.03.2004 with letter of 27.02.2004

Claims, Numbers

1-15 received on 01.03.2004 with letter of 27.02.2004

Drawings, Sheets

1/6-6/6 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/GB 03/01173**

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-15
	No: Claims	
Inventive step (IS)	Yes: Claims	1-15
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-15
	No: Claims	

2. Citations and explanations

see separate sheet

V.1 The subject-matter of claim 1 meets the requirements of Art. 33(2) and (3) PCT. Indeed, D1: WO 99 66200 A, which is considered as the closest prior art, discloses an apparatus for extracting power from a fluid flow having a fluid driveable engine (see turbine (40) on fig. 3) and a conduit (30) disposed to enable fluid communication between a portion of the fluid flow and the driveable engine.

However, D1 fails to disclose that:

- the primary and the driving fluid are different fluids and that the transmission fluid is entrained within the fluid flow;
- the transmission fluid exits the conduit via a plurality of entrainment outlets;
- the size of the entrainment outlets being that of a practical bubble size.

The technical problem underlying the invention is to increase the efficiency of the hydraulic machine at different working conditions. According to the apparatus of claim 1, said technical problem is solved by the above mentioned distinguishing features.

Taking into consideration that neither D1 or D2 : US 5 377 485 A consider the possibility of the production of bubbles in order to increase the efficiency, the skilled would not be prompted to modify the apparatus of D1 providing the entrainment outlets.

The subject-matter of claim is therefore novel and inventive (Art. 33(2) and (3) PCT).

V.2 Claims 2 to 15 meet the novelty and inventive step requirements of Art 33(2) and (3) PCT as they are formulated as depending on a claim which does meet said requirements.

V.3 Each claim should univocally specify the technical features for which protection is sought without relying on references to the description or drawings (Rule 6.2(a) PCT). Said requirement is not met by claim 15, which therefore results also not clear (Art. 6 PCT).

The above solution however is a relatively low pressure device, in which the water driving the fluid driveable engine flows fairly slowly (of order 5 m/s) in comparison with what is commonplace in a typical hydroelectric installation. This speed cannot be significantly increased by constricting the pipe diameter without introducing punitive power losses, and so only a low speed water turbine can be driven by this device. Such a turbine is not well matched to the requirements of an electrical generator, which may run at typically 1500 rpm. In order to supply a useful electrical output, a large and expensive gearbox would be needed.

WO 99/66200 discloses an embodiment of the above invention in which an alternative fluid to that present in the fluid flow is used to drive the fluid driveable engine, providing a solution to these problems, but only at the expense of increasing the complexity of the apparatus and necessitating the inclusion of sealed containers underwater near to the fluid flow.

US-A5377485 discloses an electric power conversion system in which air is used to drive a turbine prior to being entrained in a fluid flow. In some embodiments a complicated switching arrangement is used to separate the air into packets within the fluid flow and avoid bubble formation.

Various respective aspects and features of the invention are defined in the appended claims.

According to one aspect of the present invention there is provided an apparatus for extracting power from a fluid flow, the apparatus comprising: a fluid driveable engine, a conduit, disposed to enable fluid communication between a portion of the fluid flow, the fluid driveable engine and a transmission fluid, the fluid in the fluid flow and the transmission fluid being different fluids the transmission fluid being a gas and the fluid flow being a liquid and the portion of the fluid flow being at a lower pressure than the transmission fluid by virtue of its flow rate, thus causing the transmission fluid to be drawn through the conduit, the transmission fluid exiting the conduit via a plurality of entrainment outlet to become entrained in the fluid flow, the fluid driveable engine being arranged such that the flow of the transmission fluid along the conduit acts to drive the fluid driveable engine, and the size of each of the plurality of entrainment outlets being that of a practical bubble size.

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The apparatus of the present invention alleviates the disadvantages of the prior art by enabling an alternative fluid to that present in the fluid flow to drive the fluid driveable engine without the need for additional active components such as valves and large underwater structures such as containers. The use of an alternative fluid as the drive fluid enables appropriate fluids to be chosen to provide advantages such as a reduction in frictional losses and/or reduction in corrosion or erosion suffered by the device.

CLAIMS

1. An apparatus for extracting power from a fluid flow, the apparatus comprising:
5 a fluid driveable engine,
a conduit, disposed to enable fluid communication between a portion of the fluid flow, the fluid driveable engine and a transmission fluid, the fluid in the fluid flow and the transmission fluid being different fluids the transmission fluid being a gas and the fluid flow being a liquid and the portion of the fluid flow being at a lower
10 pressure than the transmission fluid by virtue of its flow rate, thus causing the transmission fluid to be drawn through the conduit exiting the conduit via a plurality of entrainment outlets to become entrained in the fluid flow, the fluid driveable engine being arranged such that the flow of the transmission fluid along the conduit acts to drive the fluid driveable engine, and the size of each of the plurality of entrainment
15 outlets being that of a practical bubble size.
2. Apparatus as claimed in claim 1, comprising:
at least one fluid directing formation formed to define a channel in the fluid flow having a flow accelerating constriction shaped such that the fluid in the channel is
20 caused to accelerate as it flows through the flow accelerating constriction of the channel.
3. Apparatus according to claim 1, in which the fluid flow comprises a flow along a conduit between two positions in a fluid stream, a conduit inlet position being at a
25 higher fluid pressure than a conduit outlet position by virtue of a lower pressure velocity at the conduit outlet position.
4. Apparatus according to claim 3, comprising a fluid directing formation for constricting the fluid stream at the conduit outlet position with respect to the fluid
30 stream at the conduit inlet position.

5. Apparatus as claimed in any one of the preceding claims, wherein the fluid flow comprises a flow of water.

6. Apparatus as claimed in any one of the preceding claims, wherein the transmission fluid comprises air.

7. Apparatus according to any one of the preceding claims, in which the fluid driveable engine comprises a turbine.

8. Apparatus according to claim 7, comprising a heat exchanger in the transmission fluid flow path at a transmission fluid exhaust of the turbine.

9. Apparatus according to claim 8, in which the heat exchanger is arranged to cool the transmission fluid.

10. Apparatus according to claim 8, in which the heat exchanger is arranged to cool a further transmission fluid in communication with external plant.

11. Apparatus according to claim 8, in which the heat exchanger is arranged to condense water vapour from ambient air.

12. Apparatus according to any preceding claim, wherein the conduit is linked to a manifold from which a plurality of smaller conduits pass, each of said smaller conduits comprising an entrainment outlet.

13. Apparatus according to any one of claims 1 to 11, wherein said plurality of entrainment outlets are formed within a porous material.

14. Apparatus according to any preceding claim, the conduit comprising fluid directing formation, the fluid direction formations being arranged so as to cause downward flowing fluid to spin about a longitudinal axis.

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15. Apparatus for extracting power from a fluid flow, the apparatus being substantially as hereinbefore described with reference to the accompanying drawings.